Does Love Really Make Mothers Blind? A Large Transcontinental Study on Mothers' Awareness About Their Children's Weight

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NS: data analysis

PB: data analysis

GL: data interpretation, manuscript drafting

Study Importance Questions

What is already known?

- Children with overweight/obesity are likely to be perceived as at a healthy weight by their parents

What does your study add?

- Misperception rates are constant and high in the ten countries studied
- Misperceived children are less likely to be involved in programs to lose weight

Objective. To assess maternal misperception rates (perception as normal or underweight of a child with overweight/obesity) and their role in affecting the chance of implementing actions to change children's weight.

Methods. OBEY-AD is an international study investigating factors promoting childhood overweight and obesity in 10 countries, in which a total sample of 2720 child-mother dyads has been enrolled. Mothers' perception of their children's weight was assessed using a projective test. Children's weight status was measured according to the anthropometric standards established by the World Health Organization.

Results. Mothers classified 89% of children with overweight and 52% of children with obesity as normal weight. Odds ratio (OR) of mothers' misperception was significantly higher for higher parental BMI, higher children's IBAI score and high family socio-economic status. Children with overweight/obesity who were perceived as normal weight by their mothers were less likely to be referred to specific healthcare services.

Conclusions. Most children with overweight/obesity were perceived as normal weight by their mothers. Such lack of concern regarding a severe disease might interfere with the effectiveness of prevention programs. Considering the contextual factors that frame the etiological causes of a disease may help in finding effective and enduring solutions to target childhood obesity.

Introduction

The prevalence of overweight and obesity in children is dramatically rising in both developed countries (DC) and newly industrialized countries (NIC), where excess weight now affects more people than undernutrition (1). This phenomenon represents a severe public health burden because overweight/obesity in childhood are likely to persist into adult age (2). Additionally, obesity has been proven to be associated with an early impairment of cardiovascular (3) and metabolic (4) systems, resulting in a high risk of developing non-communicable diseases. Lifestyle (referring especially to unhealthy eating habits and sedentary behaviors) has been demonstrated to be strongly related with increased childhood obesity rates (5). Consequently, several public health policies, at both the international and national levels, are being aimed at improving the burden of childhood obesity by modifying lifestyle habits (improving physical activity and dietary patterns, reducing sedentary behaviors and the intake of energy-dense food and beverages). However, studies that assess the impact of these public health policies on children's dietary and physical activity patterns often demonstrate poor compliance with national and international recommendations (6).

The factors more often associated with poor adherence to nutritional recommendations are the family's characteristics (children from families with a low socio-economic status have been found to be less likely to meet nutritional guidelines) (7). Recently, parents' misperception of their children's body size has also been hypothesized to be related to poor dietary patterns (8) and to affect the likelihood of losing weight (9). If a child with overweight/obesity is not correctly perceived by his parents (that is, the parents perceive their child as normal or even underweight), it is unlikely that they will change their child's weight by improving dietary patterns and physical activity levels. Parents' misperception of their children's weight has been reported in several studies conducted worldwide: It has been shown, indeed, in Europe (from south to north) (10,

11), the American double-continent (12–15), Asia (16) and Australia (17) that most children with overweight/obesity are perceived by their parents as leaner than they are.

Understanding factors associated with mothers' misperception and its role in adopting behaviors to change weight is relevant for epidemiologists and policy makers when designing ad hoc strategies to fight the obesity epidemic. Several studies have investigated predictors of parental misperception by reporting heterogeneous factors. Socio-economic status, parents' education level and BMI, children's age and sex (sons are generally more likely to be misperceived than daughters) are factors most frequently found to increase the risk of misclassification (12).

The aim of the present study was to assess rates of maternal misperception (in terms of perception as normal or underweight of a child with overweight/obesity) and its role in affecting the chance of implementing actions to change children's weight in a large multicenter cross-sectional study involving ten countries in Europe, South America and Asia.

As most studies usually focus on epidemiological factors, socio-demographic variables and healthcare policies, the current research, as suggested by a recent meta-analysis about pediatric weight-underestimation (18), aims also to access the socio-psychological context within which this phenomenon is embedded. Especially the socio-experimental approach proposed by Asch (19) showed how the influence of collectively shared and, consequently, culturally legitimated patterns of attitudes and opinions can distort even phenomenic evidence that has been correctly perceived on a sensorial level. The famous experiment about conformity (19) underlined, indeed, that an evaluation expressed by a unanimous majority predominates one's individual skill to accurately perceive an empirical reality.

Methods

Study Population

This study consisted of secondary analysis of the OBEY-AD international project (20), which investigated the effect of non-traditional risk factors on childhood obesity. Data were collected from 2720 children (3-11 years of age, balanced by sex) in ten countries: Chile (80), Mexico (120), Argentina (120), Brazil (360), Germany (60), France (60), Italy (60), United Kingdom (60), Georgia (120) and India (1680). Details of the study protocol are given elsewhere (20). Children were enrolled in school facilities in metropolitan areas in each of the countries considered in the study: Buenos Aires (Argentina), Fortaleza (Brazil), San Louis Potosí (Mexico), Paris (France), New Delhi, Kolkata, Surat, Mumbai, Hyderabad, Bangalore, Chennai (India), London (United Kingdom), Hamburg (Germany), Tbilisi (Georgia), Trieste (Italy), and Santiago (Chile).

Children with psychological and/or physical diseases were excluded from the study. Parents were asked to sign an informed consent explaining the study's aim. All observational and analytical procedures followed the ethical guidelines established by the American Psychological Association (APA) (21) and were also approved by the relevant institutional review boards.

Anthropometric Measurements

Children were weighed and measured using a balance scale and a body meter with wall stop. Body mass index (BMI) was computed as weight divided by height squared. BMI z-score was calculated according to World Health Organization (WHO) 2007 growth charts for children from 5 to 19 years (22) and the WHO Multicenter Growth Reference Study (MGRS) for those aged 0-5 (23). Children's BMI z-score was classified as following: a) underweight: z-BMI <-2; b) normal weight: $-2\leq$ z-BMI ≤ 1; c) overweight: $1<$ z-BMI ≤ 2; d) obesity: z-BMI >2. For the analyses, both the BMI z-score classification, as described above, and its dichotomized version (underweight/normal weight vs. overweight/obesity) were used.

Study questionnaire

Mothers' misperception rates and associated factors were assessed using a cross-sectional questionnaire adapted to local characteristics; both international and local versions were properly validated. This tool consisted of four main parts. The first investigated the family's socio-demographic characteristics (socio-economic status, parents' occupational status and education level) and lifestyle; the second section assessed children's eating and feeding practices in early childhood; the third assessed the mother's perception of children's body size; and, finally, the last focused on evaluating children's daily activities (weekly physical activity hours, time spent watching television, and time spent playing videogames).

Mothers' perception of their children's weight status was evaluated using a projective-iconographic test. The tool was composed of 14 images (7 for each sex). Images showed children with different body sizes (from extreme leanness to obesity) and mothers were asked to choose the figure corresponding to their own children's size. Figures were designed by evidencing physical characteristics, commonly denoted by a specific body size (e.g., leanness is represented with a thin figure in which ribs are evident), allowing mothers to easily recognize what figure best represented their child (details of the tool are available elsewhere (16)).

This projective test is an instrument for qualitative investigation, and, as such, it is meant to clarify the parent's psychological positioning concerning their subjective perception about their children's weight. Findings, therefore, belong only to a descriptive level and do not constitute any element for quantitative generalizability.

Although interesting, few children, limited to one country (India), were underweight and misperceived; thus, they were excluded from the subsequent analysis, where we focused on overweight/obesity.

Brand Awareness

Children's affiliation with trademarks of energy-dense food products (especially fast food and salty and sweet snacks) was assessed using the International Brand Awareness Inventory (IBAI), a validated questionnaire consisting of 12 de-identified food product brand logos (both international and country-specific). Children were asked to recognize the brand, match the brand to the corresponding food image chosen from 4 different options, and finally name the food product. The IBAI score could range from a minimum of 0 to a maximum of 36 points. A detailed description of the instrument (http://www.brand-ibai.com/) and of the procedure used to administer it are given elsewhere (24–26).

Statistical analysis

Basic exploratory data analysis has been performed on the sample and reported using median (I-III quartiles) values for continuous variables and percentages (absolute numbers) for categorical variables, whenever appropriate. Chi-square tests or Wilcoxon signed-rank tests have been used to evaluate the significance of differences in factor distribution in univariable analysis.

Multiplicity p-value adjustment has been performed using the Benjamini-Hochberg procedure (27). Agreement between mothers' perception and children's actual body size was assessed using Fleiss' Kappa measure. Perception as normal of a child with overweight/obesity and a decision to act to reduce children's body weight were treated as binary responses and constituted the two main outcomes of the analysis.

A fixed and random effect meta-analysis of the proportion of children with overweight/obesity perceived as normal among different countries was computed. Estimates of proportions and related 95% confidence intervals combined with the pooled estimate were reported in a forest plot. Heterogeneity across countries was assessed using I^2 and τ^2 statistics.

The interactions between the main outcome and brand awareness and the mother's and father's BMI were studied by a multivariable logistic regression model, adjusted by country using robust

estimates (28). Cubic splines were used to model no-linear effects of the covariates. Model fit was assessed via Somer's Dxy, adjusted for optimism using a 10,000-replica bootstrap. Analyses were performed using the R System (29) and rms (30) library.

Results

Characteristics of children, according to dichotomized BMI z-score, are presented in Table 1. Children with overweight/obesity were older (p-value 0.004) and were more likely to be boys (p-value 0.004) than under/normal-weight children were. They also spent more time watching television (p-value <0.001) and playing with videogames (p-value 0.002). Mothers and fathers of underweight/normal weight children were younger (p-value <0.001 both), leaner (p-value <0.001 for both) and engaged in physical activity more often (p-value 0.002 and 0.008, respectively) than those of children with overweight/obesity. Regarding brand awareness, children with overweight/obesity had a significantly higher score (p-value <0.001).

Factors affecting mother's misperception

Mothers' perception of their children's body weight is shown in Table 2. Among children with overweight/obesity, 89% and 52%, respectively, were classified as normal weight by their mothers. This finding is also confirmed by the overall Fleiss' Kappa, reported as 0.153, which indicates a slight agreement between mothers' perception and children's real body size. However, misperception rates (perception of a child with overweight/obesity as a healthy weight) are highly variable across countries (Figure 1). Consistent with the results on misperception rates stratified by country, the analysis on misperception rates according to cities of enrollment of Indian children (Table S1) showed that rates of children with overweight/obesity wrongly perceived are variable across cities of enrollment. However, the analysis of Fleiss' Kappa

demonstrated a substantial and consistent poor agreement between mothers' perception and children's actual body size (with overlapping 95% confidence intervals).

Misperception varies according to factors investigated, showing significant differences influencing the mother's perception in socio–demographic characteristics (family's socio-economic status and parents' age), parents' BMI and children's brand awareness (Table 3). These findings are confirmed by the multivariable model (Table 4), which shows that the likelihood of mothers' misperception of children with overweight/obesity is significantly higher for (*i*) parents with higher BMI, (*ii*) children with a higher IBAI score and (*iii*) the family's high socio-economic status.

Misperception and active behaviors to change weight

Analyzing the characteristics of children who are actively involved in a program to change their weight and comparing them to those who are not involved in such a program, we found, by univariable analysis, significant differences according to country of origin (p-value <0.001), children's brand awareness (p-value <0.001) and eating patterns (particularly in daily vegetables servings, p-value 0.015; weekly consumption of meat, p-value <0.001; and salty snacks, p-value <0.001) (Table 5).

In the multivariable model, children of mothers who misperceived their body weight are less likely to be actively enrolled in a program to lose weight (Table 6).

Discussion

A growing interest in parents' perception of their children's weight status is emerging in the literature, as has been recently demonstrated by a review in the field (18). However, heterogeneous factors are reported to be related to parents' misclassification of body size, and the impact of this phenomenon on children's weight management is not well established.

The aim of the current study was to analyze maternal misperception and its impact on the chance to change body weight in a total sample of 2720 children from 10 countries worldwide. Even though several studies have been published on the experiences of various countries (10–17), comparative analyses on this topic using a common protocol and standardized form are lacking in the literature, representing an added value of this large transcontinental study.

From the findings of this study emerged an overall poor agreement between mothers' perception and their children's effective body size, evidencing that mothers perceived as normal nearly 90% of children with overweight and about a half of children with obesity; the former finding results from exclusively national surveys that reported a positive agreement between the mothers' perception and their children's actual weight status (31).

The misperception rates of the current study, ranging from 50% to 89%, are almost always higher than those reported from previous studies: Maynard et al. (12), for instance, showed that 32% of mothers perceived their overweight children as having a normal weight. Furthermore, mothers were found to underestimate their children's overweight and obese size in 39.3% and 25.3% of instances, respectively, in Brazil (32) and in 80.4% of instances among overweight and obese children in Malaysia (33). This could be due to multiple factors: different cut-off used for BMI classification, different tools employed to evaluate parents' perception, or differences in children's ages. Above all, the main factor most likely to explain the discrepant findings between the current and previous studies is that the previous studies enrolled mostly children and mothers from exclusively national samples. Instead, in the current study, transcontinental databases have been engaged, considering the cultural, social and normative heterogeneity of different countries belonging to diversified geopolitical contexts. This may suggest that the perception of weight status might be highly influenced, on the one hand, by the peculiarity of each cultural context (in line with recent research (18)), while on the other, significant differences among the normative and symbolic structure of each country produce different social representations of reality (34).

For example, in some societies, leanness is linked to beauty, whereas for others, a plumper child looks healthier.

Regarding factors associated with mothers' misperception of their children with overweight/obesity, we found that the likelihood of such evaluation bias is higher for parents with higher BMI, high socio-economic status and higher brand awareness. The role of parental BMI in influencing underestimation, however, is disputed. Maynard et al. (12) found that the lower the mother's BMI, the higher the likelihood of misclassification, while the findings of the current study showed a positive association between these variables, consistent with what has been evidenced by Chaparro et al. (35). Additionally, we could hypothesize, without considering data about the parents' BMI but in line with other scholars (36), that parents with higher BMI, in turn, do not correctly perceive their own body size.

Among factors associated with misperception, it has been shown that high socio-economic status and high brand awareness significantly increase the risk of misclassification. Findings from the current study could be related to the fact that most children have been enrolled from middle-class families living in metropolitan areas of NIC (especially India), where a Westernization of living habits has profoundly altered the traditional social structure by the "globalization of unhealthy commodities—'McDonaldsisation' and 'Cola-nisation'" (1). A high brand awareness score, indeed, may be considered a proxy of such secular changes, reflecting the progressive adoption of Western-driven habits, especially among those with a higher socio-economic level living in urbanized contexts (37). Finally, brand awareness has been shown to be associated with higher weight in children (38). The fact that brand awareness, beyond increasing obesity risk, appears to be associated with mothers' underestimation bias seems to be the trigger of a vicious cycle: It increases the likelihood of children from middle-class families in NIC being obese and, in turn, it contributes to the maintenance of this condition since it is associated with mothers' underestimation of their children's overweight/obesity status.

Public Health Implications

For public health policies, the understanding of the complex and multi-leveled mechanisms underlying the underestimation bias of weight excess in children is critical to address such a severe and chronic disease. The findings from the current study are consistent with a few earlier studies focused on the management of childhood obesity that demonstrated that either children who correctly perceive their own weight or parents who correctly classify their children's body size are more likely to be involved in intervention programs in order to prevent, more than to treat, unhealthy weight gain (39). This result highlights the ineffectiveness of etiological public health policies intended to raise parents' awareness of overweight/obesity in childhood without considering the contextual and social framework. The new frontier for the fight against pediatric obesity is, instead, interested in the understanding of the complex correlations among multiple factors rather than in identifying an isomorphic cause-effect relation; such an intersectional perspective is also known as the Homeostatic Theory of Obesity (1).

Study limitations

Study limitations are represented, first, by the fact that only mothers' perception of children's weight was investigated. Further studies should also focus on other caregivers, principally the fathers as well as siblings and other relatives, because in most post-modern societies, the dichotomous division between "woman-caregiver" and "man-breadwinner" no longer exists in its traditional form. Moreover, as general practitioners, teachers, etc., constitute the social and extra-domestic frame of a child, future research should assess their perception of childhood obesity. Due to the logistical limits of the current survey, some significant differences occurred among the single national samples. In India, for instance, over 1680 mother-child dyads were

enrolled, while in European countries, the single-nation samples are much lower. Such a spread, however, is due to the dimensions of a country along with its overall population.

Conclusion

This study clearly showed that most children with overweight/obesity in 10 different countries worldwide are perceived as normal or even underweight by their mothers. These findings suggest that public health policies should empower parents' concern regarding their children's weight status since it has been demonstrated that a correct perception of children's body size constitutes a primary predictor of involvement in weight-loss programs.

On an applicative level, the results of the current study may predict the inclusion of a constant assessment of parents' perception of their child's weight status.

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Tables

Table 1. Overall sample description according to children's status. Data are percentages (absolute number) for categorical variables and I quartile/median/III quartile for continuous ones.

	Normal weight/Underweight children	*Children with obesity/overweight*	*Combined*	*P-value*	*P-value adjusted*
	(N=1940)	(N=774)	(N=2714)		
Nation: Argentina	4% (75)	6% (45)	4% (120)	<0.001	<0.001
Brazil	12% (236)	16% (124)	13% (360)		
Chile	1% (25)	7% (54)	3% (79)		
France	2% (41)	2% (19)	2% (60)		
Georgia	4% (71)	6% (49)	4% (120)		
Germany	3% (49)	1% (11)	2% (60)		
Great Britain	2% (42)	2% (18)	2% (60)		
India	67% (1298)	49% (377)	62% (1675)		
Italy	2% (30)	4% (30)	2% (60)		
Mexico	4% (73)	6% (47)	4% (120)		
Child's BMI z-score	-1.63/-0.67/ 0.13	1.38/ 1.88/ 2.58	-1.20/-0.02/ 1.18	<0.001	<0.001
Gender, *Male*	48% (932)	55% (423)	50% (1355)	0.002	0.004
Age	5/6/8	5/7/9	5/7/9	0.002	0.004
Number of Sisters	0/0/1	0/0/1	0/0/1	0.945	0.945
Number of Brothers	0/0/1	0/0/1	0/0/1	0.228	0.296
Mother's Age	34.00/37.00/41.00	35.00/38.00/42.50	34.00/37.50/41.25	<0.001	<0.001
Mother's Physical Activity (hours/week)	2.0/5.0/8.0	1.0/3.0/7.0	1.6/4.0/8.0	0.001	0.002
Father's Age	30/33/36	31/34/38	30/33/36	<0.001	<0.001
Father's Physical Activity (hours/week)	2.00/ 5.00/10.00	1.00/ 4.75/ 8.00	2.00/ 5.00/ 9.00	0.005	0.008

Mother's BMI	21.21/23.43/25.89	22.51/24.76/27.65	21.60/23.80/26.41	<0.001	<0.001
Mother's Education Level: primary education	30% (573)	30% (233)	30% (806)	0.005	0.008
Secondary education	67% (1304)	67% (519)	67% (1823)		
Post-secondary education	0% (4)	1% (8)	0% (12)		
None	3% (59)	2% (13)	3% (72)		
other	0% (0)	0% (1)	0% (1)		
Fathers who have a job	84% (1635)	85% (661)	85% (2296)	0.465	0.550
Father's Education Level: primary education	34% (573)	30% (233)	30% (806)	<0.001	<0.001
secondary education	67% (1304)	67% (519)	67% (1823)		
Post-secondary education	0% (4)	1% (8)	0% (12)		
None	3% (57)	2% (13)	3% (70)		
Number of TV in the house	1/1/2	1/2/2	1/1/2	<0.001	<0.001
Children who have a TV in their bedroom	18% (344)	28% (218)	21% (562)	<0.001	<0.001
Time the child spent watching TV (hours/week)	7.0/11.0/17.0	7.2/12.0/18.0	7.0/11.0/17.0	<0.001	<0.001
Usual Means of Transport: animal-drawn cart	0% (2)	0% (0)	0% (2)	<0.001	<0.001
bicycle	11% (153)	8% (38)	10% (191)		
car	36% (498)	45% (218)	38% (716)		
motorcycle or scooter	39% (546)	24% (115)	35% (661)		
none of the above	12% (166)	15% (70)	13% (236)		
public transportation	2% (29)	8% (39)	4% (68)		
Time the child spent playing videogames (hours/week): 2-3 hours	6% (107)	9% (70)	7% (177)	0.001	0.002
4 hours	1% (17)	1% (9)	1% (26)		
half an hour to 1 hour	23% (452)	26% (199)	24% (651)		
less than half an hour	19% (375)	21% (161)	20% (536)		
more than 4 hours	1% (15)	1% (6)	1% (21)		
not at all	50% (974)	43% (329)	48% (1303)		
Age until which the child was breastfed (months)	6/12/24	6/12/24	6/12/24	0.383	0.467
Meals with family (number/week)	2/6/7	2/6/7	2/6/7	0.864	0.936
Mother's Perception of child's weight: about the right weight	71% (1384)	66% (513)	70% (1897)	<0.001	<0.001

not sure	14% (276)	10% (74)	13% (350)		
too heavy	1% (28)	22% (168)	7% (196)		
too light	13% (252)	2% (19)	10% (271)		
Children who usually have breakfast every day	83% (1612)	85% (660)	84% (2272)	0.165	0.222
Children who usually have a morning snack every day	45% (873)	46% (356)	45% (1229)	0.638	0.711
Children who usually have lunch every day	98% (1901)	98% (758)	98% (2659)	0.924	0.945
Children who usually have an afternoon snack every day	63% (1227)	67% (520)	64% (1747)	0.053	0.077
Children who usually have dinner every day	97% (1884)	97% (748)	97% (2632)	0.516	0.592
Daily Fruit Portions: 1	48% (929)	47% (361)	48% (1290)	0.91	0.945
2	28% (552)	29% (225)	29% (777)		
3	8% (159)	9% (67)	8% (226)		
4	3% (52)	2% (16)	3% (68)		
more than 4	4% (71)	4% (29)	4% (100)		
no one	9% (177)	10% (76)	9% (253)		
Daily vegetables portions: 1	34% (668)	36% (280)	35% (948)	0.105	0.146
2	33% (647)	34% (262)	33% (909)		
3	11% (223)	13% (101)	12% (324)		
4	4% (81)	2% (17)	4% (98)		
more than 4	5% (88)	4% (28)	4% (116)		
no one	12% (233)	11% (86)	12% (319)		
Fish consumption (number/week)	1/1/2	1/2/2	1/1/2	0.292	0.367
Meat consumption (number/week)	1/2/4	2/3/4	1/2/4	<0.001	<0.001
Salty Snack Consumption: at least once a week	9% (172)	13% (96)	10% (268)	0.005	0.008
more than once a day	9% (172)	9% (65)	9% (237)		
never	8% (153)	9% (64)	8% (217)		
once a day	26% (477)	20% (148)	24% (625)		
rarely	48% (891)	50% (374)	48% (1265)		
Candy/Choco Consumption: at least once a day	17% (324)	14% (101)	16% (425)	<0.001	<0.001
at least once a week	10% (192)	16% (118)	12% (310)		

more than once a day	0% (2)	0% (3)	0% (5)		
never	4% (73)	3% (19)	4% (92)		
once a day	36% (672)	32% (235)	35% (907)		
rarely	32% (593)	36% (266)	33% (859)		
Soda consumption: at least once a week	8% (135)	11% (76)	9% (211)	0.005	0.008
more than once a day	7% (129)	9% (62)	8% (191)		
never	23% (403)	18% (127)	21% (530)		
once a day	12% (206)	14% (97)	12% (303)		
rarely	51% (895)	49% (342)	50% (1237)		
Child's Physical Activity Hours: about 2-3 hours	21% (410)	25% (191)	22% (601)	<0.001	<0.001
about 4-6 hours	7% (137)	10% (76)	8% (213)		
about an hour	23% (439)	23% (181)	23% (620)		
about half an hour	24% (458)	17% (131)	22% (589)		
more than 7 hours	4% (71)	6% (46)	4% (117)		
none	22% (425)	19% (149)	21% (574)		
Brand Awareness	7.00/13.00/19.00	9.00/16.00/22.75	8.00/14.00/20.00	<0.001	<0.001
Family's Socio-Economic Status: low socio-economic status	66% (1288)	60% (465)	65% (1753)	0.002	0.004
Father's BMI	22.58/24.72/26.77	23.80/25.91/28.40	22.94/24.97/27.34	<0.001	<0.001
Mothers who have a job	40% (774)	48% (368)	42% (1142)	<0.001	<0.001

Table 2. Mothers' perception of body weight classified according to actual body. Overall Fleiss Kappa 0.153 p-value <0.001.

Actual body (columns)	*Underweight*	*Healthy weight*	*With obesity*	*With overweight*
Perception	(N=342)	(N=1598)	(N=343)	(N=431)
Too light	27% (72)	13% (180)	2% (7)	3% (12)
About the right weight	72% (194)	85% (1190)	52% (159)	89% (354)
Too heavy	1% (2)	2% (26)	45% (137)	8% (31)
Fleiss Kappa	**0.173 (p<0.001)**	**0.087 (p<0.001)**	**0.229 (p<0.001)**	

Table 3. Perception as normal of an overweight/obese child according to factors investigated. Data are percentages (absolute number) for categorical variables and I quartile/median/III quartile for continuous ones.

	Normal weight/Underweight children perceived as normal weight	*Children with obesity/overweight perceived as normal weight*	*Combined*	*P-value*	*P-value adjusted*
	(N=1785)	(N=513)	(N=2298)		
Nation: Argentina	5% (82)	7% (36)	5% (118)	<0.001	<0.001
Brazil	15% (259)	15% (76)	15% (335)		
Chile	3% (47)	5% (27)	3% (74)		
France	2% (41)	3% (17)	3% (58)		
Georgia	5% (86)	6% (32)	5% (118)		
Germany	3% (48)	2% (8)	2% (56)		
Great Britain	2% (37)	3% (15)	2% (52)		
India	60% (1066)	48% (245)	57% (1311)		
Italy	2% (34)	5% (24)	3% (58)		
Mexico	5% (85)	6% (33)	5% (118)		
Child's BMI z-score	-1.00/-0.21/ 0.53	1.28/ 1.66/ 2.25	-1.20/-0.02/ 1.18	<0.001	<0.001
Gender: M	48% (848)	54% (276)	49% (1124)	0.012	0.039
Age	5/7/9	5/7/9	5/7/9	0.686	0.723
Number of Sisters	0/0/1	0/0/1	0/0/1	0.198	0.336
Number of Brothers	0/0/1	0/0/1	0/0/1	0.028	0.061
Mother's Age	34.00/38.00/42.00	35.00/38.00/43.00	34.00/37.50/41.25	0.025	0.057
Mother's physical activity (hours/week)	1.0/4.0/8.0	1.0/3.0/7.0	1.6/4.0/8.0	0.09	0.167
Father's Age	30/33/36	31/34/38	30/33/36	0.005	0.02
Father's physical activity (hours/week)	2/5/9	1/4/8	2/5/9	0.094	0.167
Mother's BMI	21.41/23.72/26.32	22.31/24.22/27.34	21.60/23.80/26.41	<0.001	<0.001

Mother's education level: primary education	31% (553)	30% (153)	31% (706)	0.891	0.891
Secondary education	66% (1180)	68% (347)	66% (1527)		
Post-secondary education	0% (8)	1% (3)	0% (11)		
none	3% (51)	2% (10)	3% (61)		
other	0% (1)	0% (0)	0% (1)		
Fathers who have a job	84% (1505)	86% (439)	85% (1944)	0.486	0.611
Father's education level: primary education	35% (624)	35% (182)	35% (806)	0.31	0.465
Secondary education	62% (1102)	63% (322)	62% (1424)		
Post-secondary education	1% (9)	0% (2)	0% (11)		
none	3% (53)	1% (7)	3% (60)		
Number of TVs in the House	1/1/2	1/2/2	1/1/2	<0.001	<0.001
Children who have a TV in their bedroom	21% (366)	26% (135)	22% (501)	0.005	0.02
Time the child spent watching TV (hours/week)	7/11/17	7/11/18	7/11/17	0.469	0.61
Usual means of Transport: animal-drawn cart	0% (1)	0% (0)	0% (1)	0.001	0.006
bicycle	10% (122)	10% (29)	10% (151)		
car	38% (457)	46% (140)	40% (597)		
motorcycle or scooter	36% (432)	24% (73)	34% (505)		
none of the above	12% (142)	14% (42)	12% (184)		
public transportation	4% (45)	7% (20)	4% (65)		
Time the child spent playing videogames (hours/week): 2-3 hours	7% (122)	8% (39)	7% (161)	0.33	0.477
4 hours	1% (14)	1% (7)	1% (21)		
half an hour to 1 hour	24% (426)	27% (137)	24% (563)		
less than half an hour	19% (340)	19% (96)	19% (436)		
more than 4 hours	1% (18)	0% (2)	1% (20)		
not at all	48% (865)	45% (232)	48% (1097)		
Age until which the child was breastfed (months)	6/12/24	6/12/24	6/12/24	0.639	0.712
Meals with the family (number/week)	2/6/7	2/6/7	2/6/7	0.556	0.678
Mother's perception of the child weight: about the right weight	67% (1190)	100% (513)	74% (1703)	<0.001	<0.001

not sure	11% (202)	0% (0)	9% (202)		
too heavy	11% (194)	0% (0)	8% (194)		
too light	11% (199)	0% (0)	9% (199)		
Children who usually have breakfast every day	83% (1481)	85% (437)	83% (1918)	0.234	0.38
Children who usually have morning snack every day	46% (818)	44% (228)	46% (1046)	0.58	0.685
Children who usually have lunch every day	98% (1744)	98% (503)	98% (2247)	0.638	0.712
Children who usually have afternoon snack every day	65% (1161)	70% (357)	66% (1518)	0.055	0.113
Children who usually have dinner every day	97% (1729)	97% (498)	97% (2227)	0.806	0.827
Daily fruit portions: 1	47% (843)	47% (239)	47% (1082)	0.661	0.716
2	28% (502)	30% (155)	29% (657)		
3	8% (150)	9% (48)	9% (198)		
4	3% (47)	3% (13)	3% (60)		
more than 4	4% (63)	4% (18)	4% (81)		
no one	10% (180)	8% (40)	10% (220)		
Daily vegetables portions: 1	35% (627)	36% (184)	35% (811)	0.089	0.167
2	34% (599)	35% (178)	34% (777)		
3	11% (195)	13% (68)	11% (263)		
4	4% (73)	2% (9)	4% (82)		
more than 4	4% (71)	4% (21)	4% (92)		
no one	12% (220)	10% (53)	12% (273)		
Fish consumption (number/week)	1/1/2	1/2/2	1/1/2	0.392	0.527
Meat consumption (number/week)	1/2/4	2/3/4	1/2/4	0.016	0.045
Salty Snack consumption: at least once a week	11% (188)	13% (66)	12% (254)	0.261	0.407
more than once a day	9% (148)	8% (40)	9% (188)		
never	9% (147)	9% (45)	9% (192)		
once a day	23% (397)	19% (94)	22% (491)		
rarely	49% (833)	50% (247)	49% (1080)		
Candies/Choco consumption: at least once a day	16% (267)	14% (70)	15% (337)	0.021	0.051
at least once a week	12% (208)	17% (81)	13% (289)		

more than once a day	0% (3)	0% (2)	0% (5)		
never	4% (63)	2% (12)	3% (75)		
once a day	36% (613)	30% (148)	35% (761)		
rarely	32% (555)	36% (175)	33% (730)		
Soda consumption: at least once a week	9% (142)	12% (55)	9% (197)	0.357	0.497
more than once a day	8% (133)	8% (39)	8% (172)		
never	21% (347)	19% (90)	21% (437)		
once a day	13% (204)	13% (59)	13% (263)		
rarely	49% (795)	48% (224)	49% (1019)		
Child's Physical Activity Hours: about 2-3 hours	23% (412)	24% (122)	23% (534)	0.002	0.01
about 4-6 hours	7% (133)	11% (55)	8% (188)		
about an hour	23% (408)	25% (128)	23% (536)		
about half an hour	22% (384)	16% (82)	20% (466)		
more than 7 hours	4% (68)	6% (32)	4% (100)		
none	21% (380)	18% (94)	21% (474)		
Brand Awareness	8/14/20	9/15/22	8/14/20	0.007	0.025
Family's Socio-Economic Status: low socio-economic status	65% (1153)	59% (302)	63% (1455)	0.018	0.047
Father's BMI	22.85/24.91/27.09	23.67/25.54/27.99	22.94/24.97/27.34	<0.001	<0.001
Mothers who have a job	43% (762)	49% (250)	44% (1012)	0.015	0.045

Table 4. Multivariable model for misperception of children with obesity/overweight. The model was adjusted by country and interaction term with brand awareness. Brand awareness, mother's and father's BMI are modeled using restricted cubic spline (nonlinear effect p-value, respectively, 0.042, 0.037, 0.0012); Somer's Dxy 0.582.

		OR	*95%*	*C.I.*	*p-value*
Mother's BMI	26 vs. 21	1.19	1.05	1.34	0.0045
Father's BMI	27 vs. 23	1.14	1.02	1.28	0.0231
Brand Awareness	IBAI score 20 vs. 8	1.22	1.04	1.42	0.0131
Family Socio-Economic Status	high socio-economic status vs. medium/low socio-economic status	1.4	1.12	1.74	0.003

Table 5. Children actively enrolled by their families in a program to modify child body weight. Data are percentages (absolute number) for categorical variables and I quartile/median/III quartile for continuous ones.

	No action	*Action taken*	*Combined*	*P-value*	*P-Value adjusted*
	(N=2055)	(N=665)	(N=2720)		
Overweight/Obesity Misperception	23% (411)	19% (102)	22% (513)	0.066	0.179
Nation: Argentina	5% (99)	3% (21)	4% (120)	<0.001	<0.001
Brazil	11% (222)	21% (138)	13% (360)		
Chile	3% (67)	2% (13)	3% (80)		
France	3% (58)	0% (2)	2% (60)		
Georgia	5% (106)	2% (14)	4% (120)		
Germany	3% (56)	1% (4)	2% (60)		
Great Britain	3% (55)	1% (5)	2% (60)		
India	60% (1237)	67% (443)	62% (1680)		
Italy	3% (52)	1% (8)	2% (60)		
Mexico	5% (103)	3% (17)	4% (120)		
Child's BMI z-score	-1.0975/ 0.0300/ 1.1100	-1.5525/-0.1300/ 1.5800	-1.2000/-0.0200/ 1.1800	0.315	0.437
Gender: M	50% (1032)	49% (328)	50% (1360)	0.688	0.792
Age	5/7/8	5/7/9	5/7/9	0.004	0.022
Number of Sisters	0/0/1	0/0/1	0/0/1	0.838	0.91
Number of Brothers	0/0/1	0/0/1	0/0/1	0.606	0.762
Mother's Age	34.00/37.00/41.00	35.00/38.00/42.00	34.00/37.50/41.25	0.049	0.158
Mother's Physical Activity (hours/week)	1.0/4.0/8.0	2.0/5.0/8.0	1.6/4.0/8.0	0.285	0.433
Father's Age	30/33/36	30/33/36	30/33/36	0.996	0.996
Father's Physical Activity (hours/week)	2/5/9	2/6/8	2/5/9	0.102	0.228
Mother's BMI	21.51/23.80/26.44	21.71/23.83/26.14	21.60/23.80/26.41	0.811	0.906

Mother's Education Level: primary education	29% (589)	33% (220)	30% (809)	0.15	0.248
Secondary education	68% (1400)	64% (425)	67% (1825)		
Post-secondary education	1% (11)	0% (1)	0% (12)		
none	3% (54)	3% (19)	3% (73)		
other	0% (1)	0% (0)	0% (1)		
Fathers who have a job	84% (1724)	87% (576)	85% (2300)	0.091	0.216
Father's Education Level: primary education	34% (700)	36% (240)	35% (940)	0.681	0.792
Secondary education	63% (1291)	61% (405)	62% (1696)		
Post-secondary education	1% (11)	0% (2)	0% (13)		
none	3% (53)	3% (18)	3% (71)		
Number of TVs in the house	1/1/2	1/1/2	1/1/2	0.025	0.106
Children who have a TV in their bedroom	20% (420)	22% (144)	21% (564)	0.501	0.656
Time the child spent watching TV (hours/week)	7/11/17	7/11/18	7/11/17	0.15	0.248
Usual Means of Transport: animal-drawn cart	0% (1)	0% (1)	0% (2)	0.064	0.179
bicycle	11% (150)	9% (43)	10% (193)		
car	38% (538)	38% (178)	38% (716)		
motorcycle or scooter	35% (492)	36% (171)	35% (663)		
none of the above	12% (168)	15% (69)	13% (237)		
public transportation	4% (61)	2% (8)	4% (69)		
Time the child spent playing videogames (hours/week): 2-3 hours	6% (127)	8% (50)	7% (177)	0.128	0.248
4 hours	1% (15)	2% (11)	1% (26)		
half an hour to 1 hour	24% (499)	23% (153)	24% (652)		
less than half an hour	20% (409)	19% (127)	20% (536)		
more than 4 hours	1% (13)	1% (8)	1% (21)		
not at all	48% (992)	48% (316)	48% (1308)		
Age until which the child was breastfed (months)	6/12/24	6/12/24	6/12/24	0.047	0.158
Children who usually have breakfast every day	84% (1732)	82% (544)	84% (2276)	0.133	0.248
Children who usually have morning snack every day	45% (919)	47% (312)	45% (1231)	0.322	0.437
Children who usually have lunch every day	98% (2015)	98% (650)	98% (2665)	0.622	0.762

Children who usually have afternoon snack every day	66% (1352)	60% (397)	64% (1749)	0.004	0.022
Children who usually have dinner every day	97% (1999)	96% (638)	97% (2637)	0.082	0.208
Daily Fruit Portions: 1	48% (977)	47% (315)	48% (1292)	0.145	0.248
2	30% (609)	26% (171)	29% (780)		
3	8% (170)	8% (56)	8% (226)		
4	2% (50)	3% (18)	2% (68)		
more than 4	3% (69)	5% (31)	4% (100)		
no one	9% (180)	11% (74)	9% (254)		
Daily Vegetables Portions: 1	35% (719)	35% (232)	35% (951)	0.002	0.015
2	35% (710)	30% (201)	33% (911)		
3	12% (255)	11% (70)	12% (325)		
4	3% (63)	5% (35)	4% (98)		
more than 4	4% (89)	4% (27)	4% (116)		
no one	11% (219)	15% (100)	12% (319)		
Fish Consumption (number/week)	1/1/2	1/2/2	1/1/2	0.05	0.158
Meat Consumption (number/week)	1.0/2.5/4.0	1.0/2.0/3.0	1.0/2.0/4.0	<0.001	<0.001
Salty Snack Consumption: at least once a week	11% (209)	9% (59)	10% (268)	<0.001	<0.001
more than once a day	8% (154)	13% (84)	9% (238)		
never	8% (164)	8% (53)	8% (217)		
once a day	24% (465)	25% (161)	24% (626)		
rarely	50% (980)	45% (288)	48% (1268)		
Candies/Choco Consumption: at least once a day	16% (315)	17% (110)	16% (425)	0.135	0.248
at least once a week	12% (242)	11% (68)	12% (310)		
more than once a day	0% (4)	0% (1)	0% (5)		
never	3% (59)	5% (33)	4% (92)		
once a day	35% (684)	35% (227)	35% (911)		
rarely	34% (657)	32% (203)	33% (860)		
Soda Consumption: at least once a week	8% (157)	9% (54)	9% (211)	0.011	0.052
more than once a day	7% (137)	9% (55)	8% (192)		

never	23% (417)	18% (113)	21% (530)		
once a day	11% (207)	16% (97)	12% (304)		
rarely	50% (934)	49% (304)	50% (1238)		
Child's Physical Activity Hours: about 2-3 hours	22% (449)	23% (154)	22% (603)	0.26	0.412
about 4-6 hours	8% (166)	7% (47)	8% (213)		
about an hour	22% (461)	24% (160)	23% (621)		
about half an hour	21% (435)	23% (155)	22% (590)		
more than 7 hours	5% (95)	3% (22)	4% (117)		
none	22% (449)	19% (127)	21% (576)		
Brand Awareness	7/13/20	9/15/22	8/14/20	<0.001	<0.001
Family's Socio-Economic Status: low socio-economic status	64% (1325)	65% (431)	65% (1756)	0.875	0.924
Father's BMI	23.03/24.94/27.17	22.63/24.97/27.46	22.94/24.97/27.34	0.937	0.962
Mothers who have a job	43% (877)	40% (269)	42% (1146)	0.312	0.437

Table 6. Multivariable model for decision to take action to reduce own children's weight. Data are odds ratios (OR) with 95% confidence intervals; Somer's Dxy 0.647.

Factor	*OR*	*Lower 0.95*	*Upper 0.95*
Misperception – OW/OB	0.29	0.19	0.44
Child's BMI- Obese: Healthy weight	4.68	3.29	6.64
Child' BMI - Overweight: Healthy weight	3.29	2.08	5.19
Have an afternoon snack – No/Yes	1.4	1.12	1.76
Daily Vegetables Portions - 2:1	0.8	0.62	1.04
Daily Vegetables Portions - 3:1	0.83	0.58	1.2
Daily Vegetables Portions - 4:1	1.82	1.09	3.02
Daily Vegetables Portions - more than 4:1	0.87	0.51	1.5
Daily Vegetables Portions - none:1	1.11	0.79	1.57

Figure 1. Perception as normal of children with overweight/obesity, among different countries and overall.